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DEVELOPMENT OF SNAKES AND LADDERS LEARNING MEDIA WITH THE TEAMS GAMES TOURNAMENT MODEL TO IMPROVE ELEMENTARY STUDENTS' NUMERACY SKILLS

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ABSTRACT

This study aimed to develop and evaluate the feasibility and effectiveness of Snakes and Ladders numeracy learning media integrated with the Teams Games Tournament (TGT) model for elementary geometry learning. Applying a research and development strategy along with the ADDIE model, the study included fifth-grade pupils who were split into two groups: one for experimental purposes and another as a control. Information was gathered through expert validation sheets, surveys for both students and teachers, and numeracy pretest–posttest instruments. The results of the validation indicated that the media was very valid, with scores of 92.3% and 93.8% from material experts, 91.3% from media experts, and 91.3% from practitioners. Practicality analysis indicated positive responses from students (82.92%) and teachers (96.7%), confirming the media was highly practical. Effectiveness analysis using the Independent Samples t- test revealed a significant difference in learning outcomes (Sig. 1-tailed = 0.000002 < 0.05. These results demonstrate that the Snakes and Ladders numeracy media integrated with the TGT model is feasible, practical, and effective in enhancing elementary students' numeracy skills, providing better learning outcomes than conventional instruction.

Keywords: Elementary Numeracy, Snakes and Ladders Game, Teams Games Tournament, Learning Media.

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PRELIMINARY

Numeracy is a basic competency that must be developed from elementary school onwards, as it forms the foundation for students' understanding of mathematics, problem-solving skills, and logical reasoning in everyday life. Numeracy is not only related to counting skills, but also includes the skill to comprehend, interpret, and utilize mathematical ideas, including numbers, geometry, measurement, and data and uncertainty in various real-life contexts. Various international studies confirm that mastery of numeracy in primary education has a significant impact on students' academic success at the next level (OECD, 2023; Stacey, 2015). This is in line with the mathematical competency framework proposed by Niss & Højgaard, (2019), which emphasizes that mastery of mathematical

competencies from elementary education is an important foundation for successful further learning and productive participation in social and academic life. Thus, numeracy development at the elementary school level needs to be directed towards strengthening conceptual and applied competencies in a balanced manner.

In Indonesia, students' numeracy skills are measured through the Minimum Competency Assessment (AKM), which is part of the National Assessment. The AKM numeracy test measures students' abilities in four main domains, namely numbers, algebra, geometry, and data and uncertainty. However, the AKM findings indicate that the numeracy achievements of elementary school students are still not optimal, especially in the geometry domain. Based on the 2024 AKM report card for SDIT Nur Hasan, students' numeracy scores in the number domain were 41.43, algebra 41.11, geometry 36.26, and data and uncertainty 49.82. The geometry domain received the lowest score, indicating that students' ability to understand the concepts and properties of flat shapes still needs to be improved. This discovery aligns with findings from both national and international research stating that geometric numeracy is one of the most difficult aspects for elementary school students to master because it is abstract and requires visualization and spatial reasoning skills (Clements & Sarama, 2020; Martin & Davier, 2020).

Darling-hammond et al., (2020) emphasize that learning oriented towards deep learning needs to provide opportunities for students to actively engage in problem solving, collaboration, and conceptual reflection in order to achieve meaningful and sustainable understanding. In addition, learning approaches that encourage exploration, discussion, and independent knowledge construction have been proven to be more effective in improving critical thinking skills and transferring mathematical knowledge to contextual situations.

One of the factors contributing to low numeracy achievement is the mathematics learning process that continues to rely on conventional, teacher-centered instruction, which often emphasizes procedures and memorization and results in passive student engagement. Research indicates that traditional teacher-centered approaches tend to limit opportunities for students to actively participate in constructing mathematical understanding, whereas learner-centered and active instructional strategies have been shown to increase student involvement, improve conceptual understanding, and positively affect mathematics achievement (Ulum & Tümkaya, 2022).

One innovative approach that is widely recommended in mathematics learning is Game-Based Learning (GBL). This approach utilizes games as a learning tool to increase

student motivation, engagement, and learning outcomes. Through games, abstract mathematical concepts can be presented in a more concrete and contextual manner, making them easier for elementary school students to understand. These findings are supported by a meta-analysis by Wang et al., (2022) , which shows that game-based mathematics learning significantly improves student motivation, conceptual understanding, and academic achievement compared to traditional learning. Other international studies also show that game-based learning has a positive effect on improving numeracy skills, grasping concepts and skills for solving problems in elementary education level (Foster & Shah, 2020; Plass et al., 2015).

The educational game "Snakes and Ladders" is a form of non-digital game-based learning that is relevant to numeracy learning in elementary schools. The simple and competitive structure of the game allows students to practice numeracy skills repeatedly in a fun learning environment. A number of studies in Indonesia have reported that the use of snakes and ladders media in mathematics learning can increase student engagement and learning outcomes, especially in materials that require conceptual understanding such as flat shapes, if the media is designed in accordance with learning objectives (Lestari et al., 2019; Yustitia et al., 2024).

In order for learning media to be used optimally, integration with the right learning model is necessary. Teams Games Tournament (TGT) is a collaborative educational model that emphasizes teamwork, healthy competition, and active student participation through games and tournaments. The TGT model has been proven effective in increasing student motivation and learning outcomes in mathematics because it provides opportunities for students to learn collaboratively and competitively at the same time (Slavin, 2014; Supandi et al., 2018). The integration of the snake and ladder game with the The TGT framework aims to create a more engaging, enjoyable, and student-focused learning experience, thereby supporting the improvement of numeracy skills.

Several previous studies support the importance of developing snake and ladder games to improve numeracy. For example, research by Anandifa & Wiratsiwi, (2025) found that Canva-based numeracy snake and ladder games improved learning outcomes by 60% in the fairly effective category. Furthermore, Widiastuti et al., (2024) revealed that snake and ladder games can improve students' numeracy, with an initial average of 66 compared to an average of 90 at the end of cycle II. Furthermore, Chayati et al., (2021) revealed that the snake and ladder media effectively improved students' mathematical problem-solving abilities, as shown by statistically significant preliminary research. Post-

test improvement (Sig < 0.05). In addition, mathematics learning using snakes and ladders can improve numeracy, learning motivation, and student engagement (Putri et al., 2025).

Although various studies have examined the application of game-based learning and the TGT model in mathematics learning, research that specifically focuses on creating educational resources related to the subject of "snakes and ladders" integrated with the TGT model approach aimed at enhancing the numeracy skills of elementary learners remains quite restricted. Most previous studies have emphasized the implementation aspect rather than the media development process, which includes testing for validity, practicality, and effectiveness. Therefore, this study is important to fill this gap.

Drawing from the aforementioned details, the purpose of this research is to create a snakes and ladders learning medium integrated with the Teams Games Tournament (TGT) model and to test its validity, practicality, and effectiveness in improving the numeracy skills of elementary school students, particularly in the subject of flat shapes. The findings from this research aim to assist in theoretically and practically to the development of innovative learning media and to provide an alternative solution to enhance the standard of numeracy learning in elementary schools.

METHODS

This research employed the research and development (R&D) approach utilizing the ADDIE developmental framework, which consists of stages like analysis, design, development, implementation, and evaluation. The selection of the ADDIE model was chosen its structured phases that are suitable for crafting educational resources. The flow of learning media development based on the ADDIE model is presented in Figure 1.

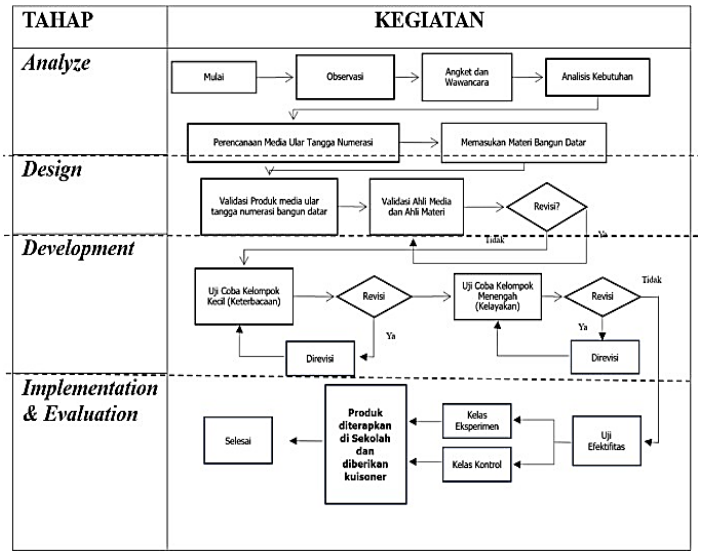

Figure 1. Research Flowchart

The research subjects in the initial trial phase were 12 students from class V-C of Nur Hasan Integrated Islamic Elementary School, while the field trial involved 24 students from class V-B as the experimental class and one class V-A as the control class. This research was conducted in the even semester of the 2025/2026 academic year at Islam Terpadu Nur Hasan Elementary School. The initial trial aimed to test the readability and feasibility of the instruments and learning media, while the field trial was conducted to test the effectiveness of the developed media.

This study used the Research and Development (R&D) method with development stages including analysis of elementary school students' numeracy learning needs, design of learning media based on the Teams Games Tournament (TGT) model, development and validation by experts, implementation through limited trials and field trials, and evaluation to determine the level of validity, practicality, and effectiveness of the media. The research instruments used included an expert validation sheet to assess the validity of the media, teacher and student response questionnaires to measure practicality, and numeracy ability tests (pre-test–post-test) to test the effectiveness of the learning media.

Numeracy ability in this study is defined as the ability of students to use numbers and mathematical symbols to solve contextual problems, identify and represent geometric objects, and determine the properties and calculations of flat shapes. This operational definition forms the basis for the development of test instruments tailored to the numeracy indicators in the fifth grade elementary school flat shape material.

This study involved three variables, namely the independent variable in the form of the application of TGT-based Numeracy Snakes and Ladders learning media, the dependent variable in the form of students' numeracy skills in flat shape material, and the control variable in the form of the use of conventional learning (textbooks and blackboards) in the control class. To maintain internal validity, both groups were taught by the same teacher, using equivalent learning materials and objectives, and were allocated the same amount of time, so that differences in numeracy results could be attributed to the treatment given.

The sampling technique used cluster random sampling, which is the random selection of classes from the four available fifth grade classes. One class was designated as the experimental class, one class as the control class, and one other class was used for instrument testing. Data collection techniques included observation, questionnaires, interviews, and numeracy tests. The data were analyzed descriptively and inferentially to determine the level of validity, practicality, and effectiveness of the developed learning media.

RESULT AND DISCUSSION

This study created a learning media in the shape of a snake and ladder game, Teams Games Tournament learning model, aimed at enhancing the numeracy of primary school children. The findings regarding the of the learning media development study are presented of the ADDIE model: analyze, design, develop, implement, and evaluate.

Analyze

During the analysis stage, researchers identified problems in numeracy learning in elementary schools, particularly in the subject of flat shapes. Based on the results of the needs analysis and initial data on students' numeracy abilities, it was found that students' understanding of the concepts and properties of flat shapes was still not optimal. This condition indicates the need for learning media that is concrete, interesting, and actively involves students so that abstract mathematical concepts can be more easily understood (Clements & Sarama, 2020; Martin & Davier, 2020). Therefore, educational games were chosen as an alternative solution that suits the characteristics of elementary school students.

Design

The design stage was carried out by developing a Snakes and Ladders numeracy learning media design using the Teams Games Tournament (TGT) learning model. The media was designed to contain flat shape material, numeracy questions, and game rules that encourage cooperation and healthy competition among students. The design process began with the creation of a game flowchart that describes the sequence of learning activities, which is presented in Figure 1.

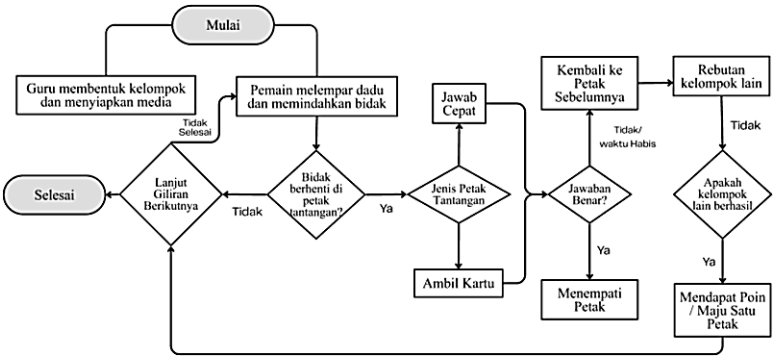

Figure 1. Snakes And Ladders Game Flowchart

In addition, the initial media design was also developed, as shown in Figure 2. In this stage, tools for research were created, including expert validation surveys, student surveys, and teacher surveys, and numeracy tests. The media design was adapted to the principles of mathematics learning that emphasize student activity, interaction, and direct involvement.

Figure 2. Numeracy Snake And Ladder Media Prototype

Development

The development stage produced the Numeracy Snakes and Ladders learning media, which underwent validation, revision, and testing for practicality and effectiveness. Validation was carried out to ensure that the developed media was appropriate regarding content, appearance, and learning implementation. The findings from the media validation, performed by media specialists, content experts, and practitioners (teachers) showed that the learning media was highly valid.

Tabel 1 . Validation Results of the Snakes and Ladders Numeracy Media

Validator	Percentage (%)	Category
Media Expert	91.3%	Very Valid
Material Expert 1	92.3%	Very Valid
Material Expert 2	93.8%	Very Valid
Practitioner (Teacher)	96.7%	Very Valid
Average	**93.5%**	**Very Valid**

Based on Table 1, the percentage of assessments from media experts was 91.3%, material experts 92.3% and 93.8%, and practitioners (teachers) 96.7%, with an overall average of 93.5%. These results indicate that the Numeracy Snake and Ladder learning media has met the eligibility criteria in terms of material, design, and learning implementation, so that it can utilized in the educational process with minor revisions.

The media was revised based on suggestions and input from media experts, particularly in terms of visuals, layout, clarity of information, and readability of game components. A comparison of the media prior to and following the revision is presented in table 2, which shows improvements in the design of the game board, colors, symbols, and clarity of instructions. These improvements aim to increase the attractiveness of the media

while making it easier for students to understand the rules of the game and the numeracy material presented.

Tabel 2. Media View after Revision from Media Expert

Before Revisi	After Revisi
	

Implement

The implementation stage aims to test the use of the "Numeracy Snakes and Ladders" learning media in the mathematics learning process and to gather information on the practicality and effectiveness of the created resource. Implementation is carried out through the application of media in learning activities on flat shapes in the experimental class. At this stage, learning was carried out in accordance with the TGT model steps, namely group formation, material presentation, implementation of the Numeracy Snake and Ladder game, and determination of group scores. During the learning process, students actively participated in games and group discussions to solve numeracy problems presented in the media. After finishing the learning process, the students were requested to take a numeracy ability posttest and to fill in a survey about their engagement with the learning resources. Teachers also filled out a a survey to evaluate the implementation of learning and the ease of use of the media. The data obtained at this stage was utilized to assess how effective the Numeracy Snakes and Ladders learning media.

Tabel 3. Student Response Results

Aspect	Score
Enjoyment	405
Interest in Learning	413
Practicality	282
Engagement in Learning	206
Numeracy	286
Total Score	**1592**
Percentage (%)	**82.92%**
interpretation	**Very Practical**

The student responses in Table 3 show a practicality percentage of 82.92% in the very practical category. These results indicate that the Numeracy Snake and Ladder learning media is capable of creating a fun learning atmosphere and increasing student active involvement in mathematics learning.

In addition, responses from educators regarding the utilization of educational media also showed very positive results.

Tabel 4. Teacher Response Results

Aspect	Score
Classroom Suitability	20
Ease of Use	14
Learning Effectiveness	15
Time Allocation	9
Total Score	**58**
Percentage (%)	**96.7%**
Interpretation	**Very Practical**

Based on Table 4, learning media obtained a percentage of 96.7% in the very practical category, which includes suitability for classroom learning, ease of use, learning effectiveness, and time allocation. This shows that learning media is easy for teachers to apply and supports the learning process effectively.

Evaluate

The evaluation stage aims to determine the extent to which the "Numeracy Snake and Ladder" learning media can enhance students' numeracy skills and meet the criteria for suitability as an effective and sustainable elementary school mathematics learning media. Product evaluation is an important stage in development research to ensure the quality of the media before it is recommended for widespread use (Branch & Varank, 2009; Sugiyono, 2012).

The evaluation of the media's effectiveness focused on the improvement of students' numeracy skills after participating in learning using the "Numeracy Snake and Ladder" media with the TGT model. The effectiveness of the educational resources was analyzed through the results of the posttest of students' numeracy skills. Before testing the effectiveness, the posttest data was first tested for prerequisites.

Tabel 5. Results of the Posttest Numeracy Ability

Test Types	Class	Sig.	Criteria	Decision
Normality (Shapiro–Wilk)	Experiment	0,397	Sig. > 0,05	Normally distributed
	Control	0,069	Sig. > 0,05	Normally

Test Types	Class	Sig.	Criteria	Decision
				distributed
Homogeneity (Levene – Based on Mean)	Experiment & Control	0,986	Sig. > 0,05	Homogeneous

Based on Table 5, the findings from the tests for normal distribution and homogeneity indicate that the data from the post-test for both the experimental and control groups exhibit a normal distribution and are homogeneous, thus fulfilling the requirements for parametric statistical tests. Next, an independent samples t-test was conducted to determine the difference in numeracy skills between the experimental class and the control class.

Tabel 6. Descriptive Statistics of Posttest Scores

Group	N	Mean	Std. Deviation
Experimental	23	67.00	10.87
Control	23	50.26	10.64

Table 6 indicates that the mean score for the experimental group (67.00) following the test surpassed that of the control group (50.26). The use of the "Numeracy Snake and Ladder" media not only improved students' numeracy achievement in general, but also had a consistent impact on most students. This finding is in line with the views of Martin & Davier, (2020) in the TIMSS study, which confirms that mathematics learning that emphasizes activities, visualization, and direct student involvement contributes positively to improving numeracy skills. To reinforce these findings, an Independent Samples t-test was conducted as presented in Table 7.

Tabel 7. Independent Samples t-test Results

Variable	t	df	p-value	Mean Difference
Posttest Score	5.278	44	0.000002	16.74

Table 7 shows a significance value of $p = 0.000002$ ($p < 0.05$), which indicates a significant difference between the numeracy skills of students in the class that used the Numeracy Snakes and Ladders learning media and those in the class that used conventional learning methods. Thus, the learning media developed proved to be more effective in enhancing students' numeracy skills. Further analysis yielded an effect size (Cohen's d) of 1.55, which falls into the category of very large effect. These results indicate that Teams Games Tournament (TGT)-based media is not only statistically significant, but also has a strong practical impact on improving students' numeracy skills. The results of this study are in line with Hattie's findings, which show that learning strategies that encourage active

student engagement and collaborative interaction have a higher effect size than conventional learning. The integration of game media with the TGT cooperative model in this study provides opportunities for students to discuss, compete healthily, and build conceptual understanding through meaningful social interaction.

The effectiveness of this media can be explained through the characteristics of the Snake and Ladder game, which presents numeracy learning in a concrete and fun context, combined with TGT syntax which encourages collaboration and positive rivalry. According to Slavin (2016), the TGT model has the potential to boost students' motivation to learn and learning outcomes because of the individual and group responsibility in achieving learning objectives. In addition, Clements & Sarama, (2020) emphasize that mathematics learning at the elementary school level will be more effective if students are involved in activities that allow for visual and contextual exploration of concepts, as facilitated by educational game media.

These evaluation results also reinforce previous research findings showing that game-based learning media and cooperative learning have a positive effect on mathematics learning outcomes. Research by Tokac et al., (2019) dan Hattie (2012) shows that game-based learning and cooperative learning have a crucial role on improving students' grasp of concepts and engagement. In the national context, the findings of this research align with the outcomes of studies by Sundayana et al. (2017) and Lestari and Yudhanegara (2019) which state that incorporating of interactive learning media and group activities can enhance learners' mathematical thinking skills, including numeracy skills.

Compared to previous studies, this study has a more specific contribution, namely systematically integrating the Snakes and Ladders game media with the TGT model to improve numeracy skills in flat shape material in elementary schools. This integration provides an alternative learning solution that does not depend on high-level digital technology, making it easier to implement in various school conditions. This finding extends previous evidence reported Aprilliani & Santi (2025), which emphasizes that numeracy in elementary mathematics learning serves as a fundamental foundation for students' future learning development. Thus, the results of this study are not only theoretically relevant but also provide practical attempts in efforts to enhance the standard of numeracy learning, as recommended by (Leinwarnd, 2014) and (OECD, 2023).

Considering the findings about its validity, practicality, and effectiveness, it is evident that the Numeracy Snake and Ladder learning fulfills the standards of validity,

practicality, and effectiveness, making it suitable for use as a mathematics learning medium to enhancing the math skills of elementary school learners.

This study has methodological limitations because all samples came from one school with relatively homogeneous characteristics, so the generalization of the findings is still limited. In addition, the determination of the control and experimental classes was based on existing class divisions without individual randomization, so the potential for differences in initial abilities between classes could not be fully controlled. The measurement of effectiveness also focused on numeracy skills in flat shapes during a limited intervention period, so that the long-term impact and application to other materials still require further research.

CONCLUSION

In this research a Snakes and Ladders numeracy learning media integrated with the Teams Games Tournament (TGT) model for fifth-grade plane geometry learning. The results demonstrate that the developed media is legitimate, practical, and efficient in improving students' numeracy skills. Expert validation confirmed the feasibility of the media, while positive responses from students and teachers indicated its practicality for classroom use. The effectiveness analysis revealed notable enhancement in the students' numeracy learning outcomes after the implementation of the media.

The findings suggest that game-based learning media combined with cooperative learning models can support active, collaborative, and meaningful numeracy learning in elementary schools. This media can be used as an alternative instructional resource to enhance students' engagement and understanding of mathematical concepts. Future studies may explore its application across different mathematical topics and educational contexts.

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